

14.0 UPPER COLUMBIA RIVER STEELHEAD ESU

14.1 BACKGROUND

14.1.1 Description of the ESU

The UCR steelhead ESU, listed as endangered on August 18, 1997 (62 FR 43937), includes all natural-origin populations of steelhead in the Columbia River basin upstream from the Yakima River, Washington, to the U.S./Canada border. The TRT has identified four extant populations; Wenatchee, Entiat, Methow, and Okanogan in the ESU. Artificially propagated Wells stock, Wenatchee River, and Omak Creek steelhead are included in the ESU.

14.1.2 Status of the ESU

Previous BRT status review of the Upper Columbia River steelhead ESU occurred in 1998 (Meyer *et al.* 1998). At that time, the BRT identified a number of concerns for the Upper Columbia River Steelhead ESU: “While the total abundance of populations within this ESU has been relatively stable or increasing, it appears to be occurring only because of major hatchery supplementation programs. Estimates of the proportion of hatchery fish in spawning escapement are 65 percent (Wenatchee River) and 81 percent (Methow and Okanogan Rivers). The major concern for this ESU is the clear failure of natural stocks to replace themselves. The BRT members are also strongly concerned about the problems of genetic homogenization due to hatchery supplementation, apparent high harvest rates on steelhead smolts in rainbow trout fisheries, and the degradation of freshwater habitats within the region, especially the effects of grazing, irrigation diversions and hydroelectric Dams.” The BRT also identified two major areas of uncertainty: relationship between anadromous and resident forms, and the genetic heritage of naturally spawning fish within this ESU.

More recently, in 2003, the BRT reviewed the status of the Upper Columbia River Steelhead ESU and concluded that based on their evaluation of the natural population, the ESU remained in the “danger of extinction” category. The most serious risk identified for this ESU was growth rate/productivity, with spatial structure and diversity still areas of concern. The last two to three years have seen an encouraging increase in the number of naturally produced fish in this ESU. However, the recent mean abundance of steelhead in the major basins is still only a fraction of interim recovery targets (Lohn 2002). Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The ratio of naturally produced adults to the number of parental spawners (including hatchery fish) remains low for Upper Columbia steelhead. The BRT did not find data to suggest that the extremely low replacement rate of naturally spawning fish (estimated adult:adult ratio was only 0.25-0.3 at the time of the last status review update) has improved substantially.

The role of resident fish above and below historical barriers was also considered by the BRT. A working hypothesis is that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in the Entiat, Methow, and perhaps Okanogan basins)

are not. For many BRT members, the presence of relatively numerous resident fish reduces the risk of extinction for the ESU as a whole but did not warrant a change from the “danger of extinction” category.

14.2 ASSESSMENT OF HATCHERY PROGRAMS

The following section presents a summary of artificial propagation programs in the UCR steelhead ESU that release steelhead juveniles into three of the four population areas. The broodstock history, similarity between hatchery-origin and natural-origin fish, program design, and program performance are described by population as listed in Table 14.1.

Table 14.1. Artificial propagation programs that release steelhead within the geographical area of the UCR steelhead ESU.

Population Program	Type	Included in ESU?	Description	Size	Year initiated
<i>Wenatchee</i>					
WDFW Wenatchee Steelhead Program	Integrated	Yes	Yearling smolt	400,000	1996
<i>Methow</i>					
WDFW Wells Stock Steelhead at Wells Hatchery	Integrated	Yes	Yearling smolt	348,000	
Winthrop NFH (Wells Stock) Steelhead	Integrated	Yes	Yearling smolt	100,000	
<i>Okanogan</i>					
Omak Creek Steelhead	Integrated	Yes	Yearling smolt	40,000	2003

14.2.1 Wenatchee River Population

The Wenatchee River steelhead population is affected by one artificial propagation program that releases steelhead within the Wenatchee River basin.

14.2.1.1 Wenatchee River Steelhead Program

This artificial propagation program is integrated with the native population and is part of the ESU. This program has research, monitoring, and evaluation activities as an integral component of the implementation plan. Since its inception, the program has made adjustments based on new information and changing conditions.

14.2.1.1.1 Broodstock History. Artificially propagated steelhead have been released into the Wenatchee River basin since the 1970s. During the first years in operation, broodstock were collected from the Columbia River at Priest Rapids Dam which is below the Wenatchee River confluence. Some Skamania stock steelhead were released during the late 1980s, but the primary broodstock collection sites were taken as volunteers to Wells Hatchery and fish collected in the

ladders at Wells Dam from 1984-1995 (located on the Columbia River above the Wenatchee River confluence). Beginning in 1996, Wenatchee River steelhead broodstock were collected from the run at large at Dryden and Tumwater Dams on the Wenatchee River (Murdoch *et al.* 1998). This program has focused on incorporating natural-origin fish into the broodstock population. Since 1998, an average of 55 percent of the broodstock was natural-origin steelhead (Murdoch *et al.* 1998, 2000a, 2000b, 2001).

14.2.1.1.2 Similarity between Hatchery-origin and Natural-origin Fish. Genetic sampling has not identified a clear geographic pattern among steelhead sampled from various locations in the Upper Columbia River basin (ICBRT 2003). However, substantial variation among sampling locations was evident indicating that some diversity remains in the ESU. Artificially propagated steelhead exhibit simplified life histories compared to natural-origin steelhead. This includes juveniles that emigrate primarily as yearlings immediately after release. Although some juveniles remain in freshwater for a year and then migrate, others residualize and never migrate seaward. Naturally produced steelhead juveniles rear in fresh water for up to seven years before emigrating (Peven 1990). Maturation of hatchery-origin fish is generally one to two months earlier than their natural-origin counterparts (Murdoch *et al.* 1998, 2000a, 2000b, 2001).

14.2.1.1.3 Program Design. Program operational practices are working toward applying the concepts and strategies of supplementation as defined and outlined in RASP (1992) and Cuenco *et al.* (1993). The Co-manager consensus goal for the program is the “*recovery of ESA listed species by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.*” Best management practices are applied to program implementation (see Management Practices for Integrated Program under Appendix A).

Artificially propagated steelhead are released into tributary areas with good quality habitat to encourage their return and eventual spawning in the natural environment. The program release level has averaged 234,000 yearling smolts of a target production level of 400,000 yearling smolts. The monitoring plan includes evaluation of differences in rearing, release, and subsequent survival to adult of artificially propagated steelhead based on parental origin (hatchery or wild). Specific matings were done between two hatchery-origin adults, two natural-origin adults, and one adult from each origin. External marks or tags (visual implant elastomer tag) were applied to all fish prior to release which enables the WDFW to not only identify fish released from this program, but from specific release groups that were released to meet specific evaluation or research objectives. Additionally, coded-wire tagging has been done in some years to verify the retention rate of the elastomer tag (A. Murdoch, WDFW, pers. comm.).

14.2.1.1.4 Program Performance. This program is funded by Public Utility District No. 1 of Chelan County (Chelan PUD) and continued operation of this program is assured through the Rock Island Dam Habitat Conservation Plan (HCP) with Chelan PUD (CPUD 2002a,b). Since this program was initiated in 1996, only three brood years have completed their life cycle. The program is increasing the abundance of steelhead returning to the Wenatchee basin (Table 14.2). The average smolt-to-adult survival for the program was 0.53 percent (1995-1997 broods) based on mark and tag identification at Priest Rapids Dam (A. Murdoch, WDFW, pers. comm.). This

survival estimate is a minimum survival because tag or mark retention may have been lower for some brood groups. Studies are underway to address this issue. Spawner to recruits ratios for 1995-1997 broods were 1.07 suggesting that hatchery-origin fish, which contributed about 43 percent of the spawners in are successfully reproducing (A. Murdoch, WDFW, pers. comm.).

No consistent difference in survival to adult among release groups of different parental origin has been observed. However, the juveniles with two natural-origin parents are consistently released at a smaller size, due in part, to the shorter period of time between spawning and smolt release. These smaller fish, in general, survival at comparable rates to the brood groups released at a larger size. Straying of Wenatchee steelhead, based on radio tag studies and observations during broodstock collection of Wells stock steelhead at Wells Dam, has occurred at levels ranging from 20 to 40 percent (English *et al.* 2001, 2003). However, this is based on only two years of data and small sample sizes.

Recently expanded redd count surveys has found hatchery-origin steelhead spawning in small tributaries in the Wenatchee basin. Hatchery-origin steelhead were commingled with natural-origin steelhead on spawning grounds near areas where the hatchery-origin steelhead were released.

14.2.1.1.5 VSP Effects. The Wenatchee steelhead program is increasing the number of steelhead spawning naturally (Table 14.2). Since the program started, about 43 percent of the fish spawning naturally were from the artificial propagation program. The diversity of the population is maintained by incorporating natural-origin fish into the broodstock. Hatchery-origin steelhead are finding suitable spawning habitats in small tributaries of the basin which may be increasing the spatial distribution of the population. Adults from this program bypassing the Wenatchee River and returning to areas above Wells Dam could be interpreted as an adverse effect on spatial distribution. However, in at least one year (2003), the flow conditions in the Wenatchee River during steelhead adult migration were abnormally low and warm. This likely exacerbated the stray rate. Additional years of monitoring are required to adequately understand any straying pattern.

14.2.2 Methow River Population

The Methow River steelhead population is affected by two artificial propagation programs that release Wells stock steelhead within the Methow River basin. Since both programs use the same broodstock, essentially have the same objective, and analysis of returns cannot be separated between the two programs, they are discussed together below.

14.2.2.1 Wells Stock Steelhead Program

The WDFW and the USFWS both have artificial propagation programs that release Wells stock steelhead into the Methow River basin. The WDFW program also releases a portion of their program into the Okanogan River basin. These programs are integrated with the native population and are included in the ESU. The WDFW program has research, monitoring, and evaluation activities included in the program. The WDFW monitoring includes the USFWS

steelhead program as well. The programs have made adjustments based on new information and changing conditions.

14.2.2.1.1 Broodstock History. Artificially propagated steelhead have been released into areas above Wells Dam, including the Methow and Okanogan Rivers since the late 1960s. Collection of steelhead broodstock occurred at both Priest Rapids and Wells Dams until 1982 (Snow 2003). After 1982, broodstock were collected at Wells Dam and Wells Hatchery. This program historically incorporated only 10 percent natural-origin fish into the broodstock annually. More recently, an increased emphasis was placed on incorporating natural-origin fish into the broodstock population. The 2004 broodstock (collected in 2003) was 30 percent natural-origin steelhead.

14.2.2.1.2 Similarity between Hatchery-origin and Natural-origin Fish. Genetic sampling has not identified a clear geographic pattern among steelhead sampled from various locations in the upper Columbia River basin (ICBRT 2003). However, substantial variation among sampling locations was evident indicating that some diversity remains in the ESU. Artificially propagated steelhead exhibit simplified life histories compared to natural-origin steelhead. This includes juveniles that emigrate primarily as yearlings immediately after release. Although some juveniles remain in freshwater for a year and then migrate, others residualize and never migrate seaward. Naturally produced steelhead juveniles rear in fresh water for up to seven years before emigrating (Peven 1990). Maturation of hatchery-origin fish is generally one to two months earlier than their natural-origin counterparts (Snow 2003).

14.2.2.1.3 Program Design. Operational practices are incrementally changing to make the program more aligned with the concepts and strategies of supplementation as defined and outlined in RASP (1992) and Cuenco *et al.* (1993). The co-manager consensus goal of the program is the “*recovery of ESA listed species by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.*”

Artificially propagated steelhead were released into tributary areas with good quality habitat to encourage their return and eventual spawning in the natural environment. The WDFW program release level has averaged 387,000 and 117,000 yearling smolts (1997-2002 broods) for a program with production targets of about 300,000 and 100,000 in the Methow and Okanogan River systems respectively. The USFWS program released about 100,000 smolts annually. Additionally, about 185,000 eggs from the earliest spawned hatchery females are sent to Ringold Hatchery to correct the disparity in maturation timing between hatchery-origin and natural-origin steelhead.

A comprehensive monitoring plan is included in the implementation plan for the WDFW program and includes monitoring of the USFWS program as well. External marks or tags have been applied to at least a portion of all steelhead prior to release which enables the WDFW to not only identify fish quickly without harming them released from this program, but identify fish from specific release groups.

A relatively new and important component of these programs is the need to manage returning hatchery-origin adults in the spawning population. A large uncertainty with this program is the potential adverse impacts associated with having large numbers of hatchery-origin steelhead commingled with a relatively small number of natural-origin steelhead. Strategies such as removal of excess hatchery-origin fish at trap sites and harvest fisheries are tools being employed to reduce the numbers of hatchery-origin fish. Evaluation of this strategy is included in the monitoring plan.

14.2.2.1.4 Program Performance. This program is funded by Public Utility District No. 1 of Douglas County (Douglas PUD) and continued operation of this program is assured through the Wells Dam Habitat Conservation Plan (HCP) with Douglas PUD (DPUD 2002). Since the listing of UCR steelhead under the ESA in 1997, this program has initiated changes to improve the operational practices of the hatchery. The smolt-to-adult survival for this program for the 1995 to 1997 broods was 1.49 percent. This is substantially higher than the Wenatchee program. However, as mentioned above, the loss of tags or marks in the Wenatchee program may have resulted in a lower than actual survival estimate. Furthermore, the manner in which this value was calculated was different from the Wenatchee due to differences in available data.

Hatchery-origin steelhead contributed over 90 percent of the spawners in the natural environment. Spawners to recruits ratios for 1995 to 1997 brood years were 0.31 suggesting that hatchery-origin fish may not be successfully reproducing.

Wells stock steelhead return to virtually all areas accessible to fish above Wells Dam. The large geographic area in which Wells stock steelhead are released confounds analysis of straying of these fish.

14.2.2.1.5 VSP Effects. The Wells stock steelhead program has increased the number of steelhead spawning naturally for many years. The effect of the hatchery-origin fish on natural production is not completely understood and is the subject of new and continuing research. However, previous analysis of natural production in the Methow set assumptions at two extremes; hatchery-origin fish are equally productive and the natural-origin spawners; or hatchery-origin fish are not productive at all. Under either scenario, productivity of steelhead spawning naturally in the Methow and Okanogan River basins remains below replacement over the long term. The dominance of hatchery-origin fish on the spawning grounds has likely reduced the diversity of the population. The spatial structure of the population may also be adversely affected because of the widespread use of Wells stock.

14.2.3 Okanogan River Population

The Okanogan River steelhead population is affected by two artificial propagation programs that release steelhead within the Okanogan River basin. The WDFW Wells stock steelhead program was discussed above. The Omak Creek steelhead program is described below

14.2.3.1 Omak Creek Steelhead Program

This artificial propagation program was initiated in 2003, and is integrated with the native population and is included in the ESU. This program has research, monitoring, and evaluation activities as an integral component of the implementation plan.

14.2.3.1.1 Broodstock History. This program began in 2003 with natural-origin broodstock collected from Omak Creek.

14.2.3.1.2 Similarity between Hatchery-origin and Natural-origin Fish. Information is not yet available for this program.

14.2.3.1.3 Program Design. Program operational practices applying the concepts and strategies of supplementation as defined and outlined in RASP (1992) and Cuenco *et al.* (1993).

Artificially propagated steelhead were released into Omak Creek that has recently been the subject of habitat improvement projects to increase the quality of the habitat. The annual program release level is 40,000 yearling smolts. The monitoring plan includes evaluation of rearing, release, and subsequent survival to adult of hatchery released steelhead. Fish are coded-wire tagged to help monitor the program.

14.2.3.1.4 Program Performance. No information is available yet regarding the performance of this program.

14.2.3.1.5 VSP Effect. The Omak Creek steelhead program is expected to increase the number of steelhead spawning naturally in the Okanogan River basin. It is also intended to increase diversity by perpetuating natural-origin steelhead specifically in Omak Creek and allow natural selection processes to work. Effects on productivity and spatial distribution for the population from the program are expected to be positive, albeit minor in relation to the ESU.

14.3 CONCLUSIONS

Existing Status: Endangered

BRT Finding: Endangered

Recommendation: Threatened

14.3.1 ESU Overview

14.3.1.1 History of Populations. The original number of populations is uncertain. Grand Coulee Dam blocked the entire Columbia Basin upstream from the dam, likely extirpating at least six populations.

Remaining populations exist in the Wenatchee, Methow, Entiat, and the Okanogan basins.

14.3.1.2 Association between Natural Populations and Artificial Propagation

Natural populations “with minimal genetic contribution from hatchery fish”

None. In the past, all of the populations have been influenced by hatchery-origin steelhead. The Entiat River is the only area that does not have a hatchery program presently.

Natural¹ populations “that are stable or increasing, are spawning in the wild, and have adequate spawning and rearing habitat”²

None

Mixed (Integrated Programs³)

Wenatchee steelhead program
Wells stock steelhead program
Omak Creek steelhead program

Hatchery (Isolated⁴)

None

14.3.2 Summary of ESU Viability

14.3.2.1 Abundance. Low abundance was determined to be a high risk factor for this ESU (BRT 2003). Natural-origin returns and the total number of natural spawners (i.e., the combination of natural-origin and hatchery-origin spring chinook included in the ESU) has increased since 1997, when the ESU was listed as endangered (Table 14.2). Preliminary ESA abundance objectives or interim abundance targets (IAT) established by NOAA Fisheries for the Wenatchee, Entiat, and Methow basins are 2,500, 500, and 2,500 natural-origin spawners, respectively (Table 14.2). The Wenatchee basin steelhead return averaged 19.7 percent of its abundance target for the five year period of 1994 to 1998 and 77.5 percent of its target for 1999 to 2003. The Methow averaged 7.0 percent and 26.6 percent for the same time periods, respectively.

¹ See HLP for definition of natural, mixed, and hatchery populations.

² HLP Point 3.

³ Integrated programs follow practices designed to promote and protect genetic diversity and only use fish from the same local population for broodstock (both natural-origin fish, whenever possible, and hatchery-origin fish derived from the same local population and included in the ESU). Programs operated to protect genetic diversity in the absence of natural-origin fish (e.g., captive broodstock programs and the reintroduction of fish into vacant habitat) are considered “integrated”.

⁴ Isolated programs do not follow practices designed to promote or protect genetic diversity. Fish that are reproductively isolated are more likely to diverge genetically from natural populations included in the ESU and to be excluded themselves from the ESU.

Table 14.2. Estimated escapement to the spawning grounds of Upper Columbia River steelhead based on dam counts.

Passage Year	Brood year	Wenatchee			Above Wells		
		Hatchery	Natural	Total	Hatchery	Natural	Total
1986	1987	4,461	1,464	5,925	12,731	503	13,234
1987	1988	2,562	2,510	5,072	4,324	871	5,195
1988	1989	1,573	1,663	3,236	3,842	573	4,415
1989	1990	1,192	1,556	2,748	4,032	576	4,608
1990	1991	725	953	1,678	3,479	340	3,819
1991	1992	939	1,612	2,551	7,114	601	7,715
1992	1993	3,103	1,050	4,153	6,726	347	7,073
1993	1994	1,007	510	1,517	2,209	191	2,400
1994	1995	2,352	454	2,806	1,981	202	2,183
1995	1996	1,612	709	2,321	829	116	945
1996	1997	1,164	351	1,515	3,867	260	4,127
1997	1998	467	495	962	3,996	111	4,107
1998	1999	76	488	564	2,486	182	2,668
1999	2000	1,031	515	1,546	3,155	402	3,557
2000	2001	746	1,497	2,243	5,759	521	6,280
2001	2002	2,184	4,391	6,575	17,293	853	18,146
2002	2003	1,362	2,063	3,425	8,793	682	9,475
2003	2004	2,673	1,224	3,897	6,642	863	7,505
Average		1,624	1,306	2,930	5,514	455	5,970
Percent IAT met ^a =			52.2%			18.2%	

^a Interim abundance targets (Lohn 2002).

14.3.2.2 Productivity. Low productivity remains a high risk factor for this ESU (BRT 2003). There is no known data indicating hatchery programs have increased ESU productivity.

14.3.2.3 Spatial Structure. Spatial structure status of the ESU, may be slightly improved because hatchery-origin steelhead were found spawning in small tributaries. However, spawning surveys effort has recently increased compared to previous years.

14.3.2.4 Diversity. The Wenatchee River program and the Omak Creek program are intended to increase the diversity of the ESU by promoting local adaptation. The Wells stock program probably reduced diversity historically, but is changing some hatchery strategies to improve diversity.

14.3.3 Artificial Propagation Record

14.3.3.1 Experience with Integrated Programs. The Wenatchee steelhead program has been operating since 1996. The Omak Creek program is too new to assess yet. The Wells program did not operate as an integrated program prior to the 1997 listing of the ESU.

14.3.3.2 Are Integrated Programs Self-Sustaining. The Wells stock steelhead has been self sustaining for many years but historically incorporated few natural-origin fish into the

broodstock.

14.3.3.3 Certainty that Integrated Programs Will Continue to Operate. Each of the propagation programs in this ESU has long-term agreements and stable funding. Monitoring and evaluation supporting effective adaptive management are strengths of these propagation programs.

14.3.4 Summary of Overall Extinction Risk Faced by the ESU

The abundance of naturally produced steelhead in the Wenatchee, Methow, and Okanogan basin has increased since the endangered listing in 1997, at least in part because of steelhead produced by hatchery programs. In addition, recent changes in the operation of hatchery programs are reducing potential adverse impacts on the ESU. The recent five year average of natural-origin steelhead return to the Wenatchee basin and to areas above Wells Dam has increased to 77.5 and 26.6 percent of the IAT, respectively. Certainty of continued hatchery program operation is provided by long term agreements with funding entities that include monitoring, evaluation, and research as integral parts of an adaptive management strategy. The increased natural-origin abundance, improved hatchery operations, stable funding, and assured program adaptation to new information moderate the risks faced by this ESU.

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